

**Mathematical modelling of spatial repellent as a complimentary
intervention to insecticide nets against malaria transmission**

Yustina Liana

Master of Science (Mathematical modelling)

University of Dar es Salaam, College of Natural and Applied Sciences, 2013

Long Lasting Insecticide Nets (LLINs) as a predominant intervention have successfully reduced malaria transmission in many endemic regions of sub-Saharan Africa. Due to changes in mosquito feeding behavior to avoid contact with LLINs by feeding early in the morning or early in the evening, there is a critical need to find other intervention tools like spatial repellents to compliment the LLINs. In this work, we develop a discrete stochastic model that describes how mosquitoes find human hosts. In the developed model, the random motion of the mosquito is modelled by Brownian motion. The mosquitoes are attracted towards the host by the human odor or repelled away from the human host by spatial repellents. The movement of the mosquito towards unprotected human hosts or away from the protected area/human host is modeled using the accept/reject rule analogous to Markov chain Monte Carlo (MCMC). The model evaluates the effect of untreated net, LLINs, short range spatial repellent and long range spatial repellent in both scattered and aggregated human population. Furthermore, the effect of combining LLINs with short or long range spatial repellent is analyzed in different human settlement patterns. The results show that the number of mosquito bites decreases with the increase in the percentage of protected human hosts. It is observed that a significant protection is conferred when long range spatial repellent is used in an aggregated population. Numerical simulation further shows that when short range repellents is used in aggregated population the nearby non-users receives more mosquito bites as compared to the case when it is used in the scattered population. Finally, it is noted that combination of LLINs with either short or long range repellents produces the same results in scattered population settlement, while the combination of LLINs and long range repellents offers significantly better protection against mosquito bite in aggregated population.